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EXAMINER	
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ART UNIT	PAPER NUMBER
1764	9

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Please find below and/or attached an Office communication concerning this application or proceeding.

10-9

Office Action Summary	Application No. 09/843,936	Applicant(s) DODD ET AL.	
	Examiner Jennifer A. Leung	Art Unit 1764	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If the period for reply specified above is the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-34* is/are pending in the application.

4a) Of the above claim(s) *11-18* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10 and 19-34* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *1-34* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 April 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *5*.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Election/Restrictions

1. Applicant's election of claims 1-10 in Paper No. 9 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

2. Claims 11-18 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim.

3. The newly added claims 19-34, drawn to the apparatus, are examined with the elected claims 1-10.

Priority

4. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Drawings

5. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because reference character **23** has been used to designate both a "pipe" leading from **22** to **18** in FIG. 1 and a "pipe" exiting from **29** in FIG. 4.

6. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: **18** in FIG. 1.

7. The drawings have not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the drawings.

8. A proposed drawing correction, corrected drawings, or amendment to the specification to add the reference sign(s) in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

9. The specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

10. Claims 1-10 and 19-34 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

With respect to claim 1, it is unclear as to the structural limitation the applicant is attempting to recite by, "connectable" (line 2) and "operable" (line 3), as they are considered vague and indefinite. Likewise, "connectable" in claim 2, line 2; claim 6, line 3; claim 7, line 7; and claim 8, lines 3 and 11.

With respect to claim 3, it is unclear as to the structural relationship of the "regeneration means" (line 2) to the other elements of the apparatus.

With respect to claim 5, it is unclear as to whether "said hydrogen" (lines 4-5) refers to the "hydrogen" of claim 5, line 3 or claim 1, line 4. Furthermore, it is unclear as to what is

intended by, "further reaction means" (line 2), and how the "further reaction means" is structurally related to the "means for the generation of electrical energy" (line 4). Furthermore, it is unclear as to whether "the regeneration means" (lines 1-2) comprises both "further reaction means" and "means for the generation of electrical energy". Also, it is suggested that "further" be changed to --additional-- or --second--, for clarity in claim terminology. Likewise in the remaining claims (i.e. claims 7, 8 and 23).

With respect to claims 9 and 10, the language of the claim is directed to a method limitation which renders the claim vague and indefinite as it is unclear as to what structural elements the applicants are attempting to recite by "the storage compound is…", since the storage compound is not an element of the apparatus. Furthermore, in claim 9, it is unclear as to whether the storage compound comprises all of the elements recited in lines 2-4.

With respect to claim 19, it is unclear as to the structural limitation the applicants are attempting to recited by "adapted to… be connected/provide/receive/reaction/store" (lines 2-7), as the phrase "adapted to" is considered vague and indefinite. It has been held that the recitation that an element is "adapted to" perform a function is not a positive limitation but only requires the ability to so perform. It does not constitute a limitation in any patentable sense. *In re Hutchinson*, 69 USPQ 138. See the remaining claims likewise. Furthermore, it is unclear as to what the applicant is attempting to recite by, "adapted to reaction".

With respect to claim 20, it is unclear as to the structural limitation the applicants are attempting to recited by "adapted to supply" (line 2), as the phrase "adapted to" is considered vague and indefinite.

With respect to claim 21, it is unclear as to the structural limitation the applicants are attempting to recited by "adapted to generate" (lines 1-2), as the phrase "adapted to" is considered vague and indefinite.

With respect to claim 23, it is unclear as to the structural limitation the applicants are attempting to recited by "adapted to… convert/generate" (lines 1-3), as the phrase "adapted to" is considered vague and indefinite. Furthermore, it is unclear as to whether "the hydrogen" (line 3) refers to "hydrogen" of claim 23, line 2 or claim 19, line 3. Furthermore, it is unclear as to what is intended by, "further reactor" (line 1), and how the "further reactor" is structurally related to the "electrical generator" (line 2). Furthermore, it is unclear as to whether "regenerator" (lines 1) comprises both "further reactor" and "electrical generator".

With respect to claims 25-26, the language of the claim is directed to a method limitation which renders the claim vague and indefinite as it is unclear as to what structural elements the applicants are attempting to recite by "the storage compound is…", since the storage compound is not considered an element of the apparatus.

With respect to claim 27, it is unclear as to the structural limitation the applicants are attempting to recited by "adapted to dry" (line 1), as the phrase "adapted to" is considered vague and indefinite.

With respect to claim 28, it is unclear as to the structural limitation the applicants are attempting to recited by "adapted to supply" (line 2), as the phrase "adapted to" is considered vague and indefinite.

With respect to claim 29, it is unclear as to the structural limitation the applicants are attempting to recited by "adapted to… react/store/convert" (lines 2-4), as the phrase "adapted to" is considered vague and indefinite.

With respect to claim 31, it is unclear as to the structural limitation the applicants are attempting to recited by "adapted to… electrolyze/receive/react/store/convert" (lines 2-9), as the phrase "adapted to" is considered vague and indefinite.

With respect to claim 32, it is unclear as to what is intended by, "the electrolyzer includes… a hydrogen source", and where it is disclosed in the specification and drawings.

With respect to claim 33, it is unclear as to the structural limitation the applicants are attempting to recited by "adapted to… be connected/provide/receive/reaction/store/automate" (lines 2-9), as the phrase "adapted to" is considered vague and indefinite. Furthermore, it is unclear as to what the applicant is attempting to recite by, "adapted to reaction".

With respect to claim 34, the language of the claim is directed to a method limitation which renders the claim vague and indefinite as it is unclear as to what structural elements the applicants are attempting to recite by "the storage compound includes methanol", since the storage compound is not considered an element of the apparatus.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

11. Claims 1-4, 9-10, 19-22, 25-26, and 28 are rejected under 35 U.S.C. 102(b) as being anticipated by Eliasson et al. (DE 4 332 789 or JP 07-149670).

With respect to claim 1, Eliasson et al. disclose a system comprising:

Electrolysis means **3** connected to supplies of water (FIG. 1, H_2O) and electricity **1**, **2** for generating hydrogen (FIG. 1, H_2);

Reaction means **4** for receiving hydrogen generated by the electrolysis means **3** and generating a storage compound (FIG. 1, CH_3OH) by reaction with carbon dioxide (FIG. 1, CO_2);

Means **5**, **6**, **6a** for the supply of carbon dioxide to the reaction means **4**; and

Storage means **7** connected to the reaction means **4** for storage of the storage compound.

With respect to claim 2, Eliasson et al. further disclose electricity generating means **1**, **2**.

With respect to claim 3, Eliasson et al. further disclose regeneration means **8** for the generation of electrical energy from the storage compound (i.e. vehicles or power stations; column 3, lines 19-22).

With respect to claim 4, Eliasson et al. further disclose that the regeneration means **8** comprises a generator (i.e. power station; column 3, lines 19-22) for the generation of electrical energy directly from the storage compound.

With respect to claims 9 and 10, Eliasson et al. further disclose that the storage compound is a C_{1-8} alcohol or a C_{1-8} hydrocarbon, namely methanol or methane (FIG. 1, "CH3OH"; column 1, lines 45-59).

With respect to claim 19, Eliasson et al. disclose a system comprising:

An electrolyzer **3** adapted to be connected to a water supply (FIG. 1, H_2O) and an electrical supply **1**, **2** for generating hydrogen (FIG. 1, H_2) via electrolysis;

A reactor **4** connected to the electrolyzer **3** for generating a storage compound (FIG. 1, CH_3OH) from hydrogen and carbon dioxide (FIG. 1, CO_2); and

A storage **7** connected to the reactor **4**, adapted to store the storage compound.

With respect to claim 20, Eliasson et al. further disclose an electrical generator **1**, **2**.

With respect to claim 21, Eliasson et al. further disclose a regenerator **8** adapted to generate electrical energy (i.e. vehicles or power stations; column 3, lines 19-22) from the storage compound.

With respect to claim 22, Eliasson et al. further disclose that the regenerator includes a generator (i.e. power stations; column 3, lines 19-22) for the generation of electrical energy from the storage compound.

With respect to claims 25 and 26, Eliasson et al. further disclose that the storage compound is a C_{1-8} alcohol or a C_{1-8} hydrocarbon, namely methanol or methane (FIG. 1, "CH3OH"; column 1, lines 45-59).

With respect to claim 28, Eliasson et al. further disclose that the electrolyzer **3** includes a solar photovoltaic **2** (FIG. 1; column 2, lines 58-60) adapted to supply electrical energy.

Instant claims 1-4, 9-10, 19-22, 25-26, and 28 read on the system of Eliasson et al.

12. Claims 1, 2, 4, 5, 7-10, 19-23, 25-26 and 29-32 are rejected under 35 U.S.C. 102(b) as being anticipated by Yutaka et al. (JP 06 295736).

With respect to claim 1, Yutaka et al. disclose a system (Abstract; Figures) comprising:

Electrolysis means **7** (section [0016]) connected to supplies of water and electricity for generating hydrogen;

Reaction means **6** for receiving hydrogen generated by the electrolysis means **7** and generating a storage compound (methanol or methane; section [0007]) by reaction with carbon dioxide;

Means **2, 3** for the supply of carbon dioxide to the reaction means **6**; and

Storage means **8** connected to the reaction means for storage of the storage compound.

With respect to claim 2, Yutaka et al. further disclose electricity generating means (Abstract; section [0016]).

With respect to claim 4, Yutaka et al. further disclose a regeneration means comprising a fuel cell (PAFC **1**; Abstract; Figures).

With respect to claim 5, Yutaka et al. further disclose regeneration means comprising a further reaction means (reformer **2**) to convert the storage compound to hydrogen, and means for generation of electrical energy from the hydrogen (PAFC **1**).

With respect to claim 7, Yutaka et al. disclose a system comprising:

Reaction means **6** for reacting hydrogen and carbon dioxide to form a storage compound;

Means for the supply of hydrogen (electrolyzer **7**) and carbon dioxide to the reaction means (reformer **2**, combustor **3**);

Storage means **8** for the storing the storage compound; and

Further reaction means (reformer **2**) for conversion of the storage compound to hydrogen.

With respect to claim 8, Yutaka et al. disclose a system comprising:

Electrolysis means **7** (section [0016]) connected to supplies of water and electricity;

Reaction means **6** for reacting hydrogen and carbon dioxide to form a storage compound;

Means (reformer **2**, combustor **3**) for the supply of carbon dioxide to the reaction means **6**;

Storage means **8** for the storing the storage compound; and

Further reaction means (reformer **2**) for conversion of the storage compound to hydrogen.

With respect to claims 9 and 10, Yutaka et al. further disclose that the storage compound is a C_{1-8} alcohol or hydrocarbon, namely methanol or methane (Abstract; section [0007]).

With respect to claim 19, Yutaka et al. disclose a system (Abstract, Figures) comprising:

An electrolyzer **7** (section [0016]) adapted to be connected to a water supply and an electrical supply for generating hydrogen via electrolysis;

A reactor **6** connected to the electrolyzer **7** for generating a storage compound (methanol or methane; section [0007]) from hydrogen and carbon dioxide; and

A storage **8** connected to the reactor, adapted to store the storage compound.

With respect to claim 20, Yutaka et al. further disclose an electrical generator (PAFC supplies direct current power to **7**; Abstract; section [0016]).

With respect to claim 21, Yutaka et al. further disclose a regenerator adapted to generate electrical energy from the storage compound (CH3OH generated by **6** used in combustion section **3**; Abstract; section [0014]).

With respect to claim 22, Yutaka et al. further disclose a fuel cell (PAFC **1**).

With respect to claim 23, Yutaka et al. further disclose the regenerator comprises a further reactor (regenerator **2**) adapted to convert the storage compound back to hydrogen and an electrical generator (PAFC **1**) for generating electrical energy from the hydrogen.

With respect to claims 25 and 26, Yutaka et al. further disclose the storage compound is a C_{1-8} alcohol or hydrocarbon, namely methanol or methane (Abstract; section [0007]).

With respect to claim 29, Yutaka et al. disclose a system (Abstract; Figures) comprising:

A first reactor **6** adapted to react hydrogen with carbon dioxide to form a storage compound;

A storage **8** connected to the reactor for storing the storage compound; and

A second reactor (reformer **2**) for converting the storage compound back into hydrogen.

With respect to claim 30, Yutaka et al. further disclose the first reactor **6** comprises a hydrogen source (electrolyzer **7**) and a carbon dioxide source (reformer **2**, combustor **3**).

With respect to claim 31, Yutaka et al. disclose a system comprising:

An electrolyzer **7** for electrolyzing water to generate hydrogen;

A carbon dioxide source (reformer **2**, combustor **3**);

A first reactor **6** to generate a storage compound from hydrogen and carbon dioxide;

A store **8** for storing the storage compound; and

A second reactor (reformer **2**) for converting the storage compound back into hydrogen.

With respect to claim 32, Yutaka et al. further disclose the electrolyzer **7** (section 0016]) includes a water source and a hydrogen source (generates hydrogen itself).

Instant claims 1, 2, 4, 5, 7-10, 19-23, 25-26 and 29-32 read on the system of Yutaka et al.

13. Claims 1-3, 9-10, 19-21, 25-26 and 28 are rejected under 35 U.S.C. 102(b) as being anticipated by Kobayashi et al. (EP 0 539 244).

With respect to claim 1, Kobayashi et al. (column 2, line 11 - column 6, line 25; FIG. 1-2) disclose a system comprising:

Electrolysis means ("1. WATER DECOMPOSITION STEP"; FIG. 1) connected to supplies of water and electricity for generating hydrogen;

Reaction means ("2. METHANOL SYNTHESIS STEP"; FIG. 1) for receiving hydrogen generated by the electrolysis means and generating a storage compound (i.e. methanol) by reaction with carbon dioxide;

Means for the supply of carbon dioxide to the reaction means ("CO2 (from outside)" and CO2 produced in area "B" in FIG. 1; column 3, line 55-column 4, line 6); and

Storage means connected to the reaction means for storage of the storage compound (column 2, line 57 - column 3, line 5).

With respect to claim 2, Kobayashi et al. further disclose electricity generating means (column 2, lines 49-56; "SOLAR ENERGY" and "CONVERSION TO ELECTRIC ENERGY" in FIG. 1).

With respect to claim 3, Kobayashi et al. further disclose regeneration means ("3. METHANOL COMBUSTION STEP" and corresponding "ENERGY RECOVERY" in FIG. 1) for the generation of electrical energy from the storage compound.

With respect to claims 9 and 10, Kobayashi et al. further disclose that the storage compound is a C_{1-8} alcohol, namely methanol ("2. METHANOL SYNTHESIS STEP", FIG. 1).

With respect to claim 19, Kobayashi et al. disclose a system comprising:

An electrolyzer ("1. WATER DECOMPOSITION STEP"; FIG. 1) adapted to be connected to a water supply and an electrical supply for generating hydrogen via electrolysis;

A reactor ("2. METHANOL SYNTHESIS STEP"; FIG. 1) connected to the electrolyzer for generating a storage compound from hydrogen and carbon dioxide; and

A storage connected to the reactor, adapted to store the storage compound (column 2, line 57 - column 3, line 5).

With respect to claim 20, Kobayashi et al. further disclose an electrical generator (column 2, lines 49-56; "SOLAR ENERGY" and "CONVERSION TO ELECTRIC ENERGY", FIG. 1).

With respect to claim 21, Kobayashi et al. further disclose a regenerator adapted to generate electrical energy from the storage compound ("3. METHANOL COMBUSTION STEP" and corresponding "ENERGY RECOVERY" in FIG. 1).

With respect to claims 25 and 26, Kobayashi et al. further disclose that the storage compound is a C_{1-8} alcohol, namely methanol ("2. METHANOL SYNTHESIS STEP", FIG. 1).

With respect to claim 28, Kobayashi et al. further disclose that the electrolyzer includes a solar photovoltaic ("SOLAR CELL SYSTEM", FIG. 1) adapted to supply electrical energy.

Instant claims 1-3, 9-10, 19-21, 25-26 and 28 read on the system of Kobayashi et al.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

14. Claims 5, 7, 8, 23 and 29-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Eliasson et al. (DE 4 332 789 or JP 07-149670) in view of Kumar et al. (U.S. 5,248,566).

With respect to claim 5, Eliasson et al. disclose a regeneration means **8** but are silent as to whether the regeneration means may comprise further reaction means to convert the storage compound into hydrogen and means for the generation of electrical energy from the hydrogen.

Kumar et al. teach a power generation system (column 2, line 32 - column 4, line 43; Figure 2; Abstract) comprising a further reaction means (partial oxidation reformer **10**) for converting a storage compound such as methanol or propane (column 1, lines 13-63; column 2, lines 32-53) into hydrogen, and further comprising a means (fuel cell **20**) for the generation of electrical energy from the hydrogen received from the further reaction means **10**.

It would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a further reaction means and means for generation of electrical energy to the apparatus of Eliasson et al. because the further reaction means allows the storage compound to be used for fueling hydrogen consumption devices (ie. fuel cells) and enables the conversion of the storage compound into hydrogen only when demanded by the device, thereby minimizing the transportation, storage, and handling risks associated with stored hydrogen (opposed to a storage compound such as methanol, which is advantageous in its liquid state under atmospheric pressure), as taught by Eliasson et al. and Kumar et al. (see also Eliasson et al.; Japanese translation sections [0006] to [0008]).

With respect to claim 7, Eliasson et al. disclose a system comprising:

Reaction means **4** providing the reaction of hydrogen (FIG. 1, H_2) with carbon dioxide (FIG. 1, CO_2) to form a storage compound (FIG. 1, CH_3OH);

Means for the supply of hydrogen **3** and carbon dioxide **5**, **6**, **6a** to the reaction means **4**; and

Storage means **7** connected to the reaction means **4** for storage of the storage compound.

However, Eliasson et al. are silent as to further reaction means connected to the storage means for providing the conversion of the storage compound back to hydrogen.

Kumar et al. teach a power generation system (column 2, line 32 - column 4, line 43; Figure 2; Abstract) comprising a further reaction means (partial oxidation reformer **10**) for converting a storage compound such as methanol or propane (column 1, lines 13-63; column 2, lines 32-53) into hydrogen.

It would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a further reaction means to the apparatus of Eliasson et al. because the further reaction means allows the storage compound to be used for fueling hydrogen consumption devices (ie. hydrogen fuel cells) and enables the conversion of the storage compound into hydrogen only when demanded by the device, thereby minimizing the transportation, storage, and handling risks associated with stored hydrogen (opposed to a storage compound such as methanol, which is advantageous in its liquid state under atmospheric pressure), as taught by Eliasson et al. and Kumar et al. (see also Eliasson et al.; Japanese translation sections [0006] to [0008]).

With respect to claim 8, Eliasson et al. disclose a system comprising:

Electrolysis means **3** connectable to supplies of water (FIG. 1, H_2O) and electricity **1**, **2** to generate hydrogen (FIG. 1, H_2);

Reaction means **4** for receiving hydrogen generated by the electrolysis means **3** and reacting with carbon dioxide (FIG. 1, CO_2) to form a storage compound (FIG. 1, CH_3OH);

Means **5**, **6**, **6a** for the supply of carbon dioxide to the reaction means **4**; and

Storage means **7** connected to the reaction means **4** for storage of the storage compound.

However, Eliasson et al. are silent as to further reaction means connected to the storage means for providing the conversion of the storage compound back to hydrogen.

Kumar et al. teach a power generation system (column 2, line 32 - column 4, line 43; Figure 2; Abstract) comprising a further reaction means (partial oxidation reformer **10**) for converting a storage compound such as methanol or propane (column 1, lines 13-63; column 2, lines 32-53) into hydrogen.

It would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a further reaction means to the apparatus of Eliasson et al. because the further reaction means allows the storage compound to be used for fueling hydrogen consumption devices (ie. hydrogen fuel cells) and enables the conversion of the storage compound into hydrogen only when demanded by the device, thereby minimizing the transportation, storage, and handling risks associated with stored hydrogen (opposed to a storage compound such as methanol, which is advantageous in its liquid state under atmospheric pressure), as taught by Eliasson et al. and Kumar et al. (see also Eliasson et al.; Japanese translation sections [0006] to [0008]).

With respect to claim 23, Eliasson et al. disclose a regenerator **8** but are silent as to whether the regenerator may comprise a further reactor to convert the storage compound into hydrogen and an electrical generator to generate electrical energy from the hydrogen.

Kumar et al. teach a power generation system (column 2, line 32 - column 4, line 43; Figure 2; Abstract) comprising a further reactor (partial oxidation reformer **10**) for converting a storage compound such as methanol or propane (column 1, lines 13-63; column 2, lines 32-53) into hydrogen, and further comprising a means (fuel cell **20**) for the generation of electrical energy from the hydrogen received from the further reaction means **10**.

It would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a further reactor and electrical generator to the apparatus of Eliasson et al. because the further reactor allows the storage compound to be used for fueling hydrogen consumption devices (ie. hydrogen fuel cells) and enables the conversion of the storage compound into hydrogen only when demanded by the device, thereby minimizing the transportation, storage, and handling risks associated with stored hydrogen (opposed to a storage compound such as methanol, which is advantageous in its liquid state under atmospheric pressure), as taught by Eliasson et al. and Kumar et al. (see also Eliasson et al.; Japanese translation sections [0006] to [0008]).

With respect to claim 29, Eliasson et al. disclose a system comprising:

A first reactor **4** adapted to react hydrogen (FIG. 1, H_2) with carbon dioxide (FIG. 1, CO_2) to form a storage compound (FIG. 1, CH_3OH); and

A storage **7** connected to the reactor **4** and adapted to store the storage compound.

However, Eliasson et al. are silent as to a second reactor connected to the storage **7** and adapted to convert the storage compound back to hydrogen.

Kumar et al. teach a power generation system (column 2, line 32 - column 4, line 43; Figure 2; Abstract) comprising a partial oxidation reformer **10** (second reactor) for converting a

storage compound such as methanol or propane (column 1, lines 13-63; column 2, lines 32-53) into hydrogen.

It would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a second reactor to the apparatus of Eliasson et al. because the second reactor allows the storage compound to be used for fueling hydrogen consumption devices (ie. fuel cells) and enables the conversion of the storage compound into hydrogen only when demanded by the device, thereby minimizing the transportation, storage, and handling risks associated with stored hydrogen (opposed to a storage compound such as methanol, which is advantageous in its liquid state under atmospheric pressure), as taught by Eliasson et al. and Kumar et al. (see also Eliasson et al.; Japanese translation sections [0006] to [0008]).

With respect to claim 30, Eliasson et al. further disclose that the first reactor **4** includes a hydrogen source **3** (FIG. 1, H_2) and a carbon dioxide source **5**, **6**, **6a** (FIG. 1, CO_2).

With respect to claim 31, Eliasson et al. disclose a system comprising:

An electrolyzer **3** adapted to electrolyze water to generate hydrogen;

A carbon dioxide source **5**, **6**, **6a**;

A first reactor **4** connected to the electrolyzer **3** and the carbon dioxide source **5**, **6**, **6a**, adapted to receive hydrogen from the electrolyzer **3** to react with carbon dioxide to form a storage compound (FIG. 1, CH_3OH); and

A store **7** connected to the reactor **4** and adapted to store the storage compound.

However, Eliasson et al. are silent as to a second reactor adapted to receive the storage compound from the store and to convert the storage compound back into hydrogen.

Kumar et al. teach a power generation system (column 2, line 32 - column 4, line 43; Figure 2; Abstract) comprising a partial oxidation reformer **10** (second reactor) for converting a storage compound such as methanol or propane (column 1, lines 13-63; column 2, lines 32-53) into hydrogen.

It would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a second reactor to the apparatus of Eliasson et al. because the second reactor allows the storage compound to be used for fueling hydrogen consumption devices (ie. fuel cells) and enables the conversion of the storage compound into hydrogen only when demanded by the device, thereby minimizing the transportation, storage, and handling risks associated with stored hydrogen (opposed to a storage compound such as methanol, which is advantageous in its liquid state under atmospheric pressure), as taught by Eliasson et al. and Kumar et al. (see also Eliasson et al.; Japanese translation sections [0006] to [0008]).

With respect to claim 32, Eliasson et al. further disclose the electrolyzer **3** comprises a water source (FIG. 1, H_2O) and a hydrogen source (FIG. 1, H_2; hydrogen generated by the electrolyzer **3**).

15. Claims 6 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Eliasson et al. (DE 4 332 789 or JP 07-149670) in view of König et al. (U.S. 4,716,859.

With respect to claim 6, Eliasson et al. further disclose that the regeneration means **8** connected to the storage means **7** may be used for generating electrical energy in a vehicle (Japanese translation section [0015]). Although Eliasson et al. does not specifically disclose an internal combustion engine, it is conventional knowledge in the art that energy in a vehicle may

be produced by the combustion of fuel in an internal combustion engine, as evidenced by König et al. To illustrate, König et al. teach an automotive fuel processing system comprising a methanol fuel storage tank **19** connected to internal combustion engine **1** (column 3, lines 1-5; column 4, lines 46-61; Figure). Thus, it would have been obvious for one of ordinary skill in the art at the time the invention was made to provide an internal combustion engine connectable to the storage means in the apparatus of Eliasson et al.

With respect to claim 24, Eliasson et al. disclose a storage **7** connected to a consumption object **8** that may be used for generating electrical energy in a vehicle (Japanese translation section [0015]). Although Eliasson et al. do not expressly specify whether the storage **7** may be vehicle storage and whether the vehicle comprises an internal combustion engine, it is conventional knowledge in the art that in order to supply a vehicle with fuel, the fuel must be stored on-board with the vehicle, and it is conventional knowledge in the art that energy in a vehicle may be produced by the combustion of fuel in an internal combustion engine, as evidenced by König et al. To illustrate, König et al. teach an automotive fuel processing system comprising a methanol fuel storage tank **19** connected to internal combustion engine **1** (column 3, lines 1-5; column 4, lines 46-61; Figure). Thus, it would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a vehicle storage and an internal combustion engine in the apparatus of Eliasson et al.

16. Claims 27 and 33-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Eliasson et al. (DE 4 332 789 or JP 07-149670), as applied to claim 19 above, and further in view of Young et al. (U.S. 5,037,518).

Eliasson et al. are silent as to whether the electrolyzer **3** includes a dryer adapted to dry the generated hydrogen.

Young et al. teach an apparatus for generating hydrogen by electrolysis of water (using electrolyzer **C**) comprising a dryer (hydrogen-water separator **21**, coalescing filter **28**, drying coil **31**, or desiccator chamber **33**) adapted to dry the generated hydrogen (column 5, line 23 - column 6, line 13; FIG. 1).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a dryer to the apparatus of Eliasson et al. because the dryer would allow water vapor entrained in the hydrogen gas exiting the electrolyzer to be separated, collected, and recycled to the initial water supply, thereby conserving resources, as taught by Young et al. In addition, most uses for hydrogen require a pure, water vapor free hydrogen, as indicated by Young et al.

With respect to claim 33, Eliasson et al. disclose a system comprising:

An electrolyzer **3** connected to a water supply (FIG. 1, H_2O) and an electrical supply **1**, **2**, the electrolyzer **3** providing for electrolysis of water to generate hydrogen (FIG. 1, H_2);

A reactor **4** connected to receive hydrogen the electrolyzer **3** and adapted to receive carbon dioxide (FIG. 1, CO_2), said reactor reacting the carbon dioxide and hydrogen to form a storage compound (FIG. 1, CH_3OH); and

A storage **7** connected to the reactor **4** and adapted to store the storage compound.

Although Eliasson et al. are silent as to a control connected to the electrolyzer, the reactor, and the storage and adapted to automate the operation of the system, the use of controls for process automation is conventional knowledge in the art, as evidenced by Young et al. To

illustrate, Young et al. teach the use of process controls (FIG. 4-11; column 2, lines 3-38; column 8, line 1 - column 14, line 22) to automatically adjust the supply of electrical power to the electrolyzer in response to changes in water supply level (i.e. to prevent the "drying out" of the electrolyzer membrane) or changes in the electrical conductiviy of the water supply (i.e. to prevent "poisoning" of the membrane due to impurities such as metals, salts, acids, bases, or other electrolytes). Therefore, it would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a control connected to the electrolyzer, the reactor, and the storage in the apparatus of Eliasson et al.

With respect to claim 34, Eliasson et al. further disclose the storage compound comprises methanol (FIG. 1, "CH3OH"; column 1, lines 45-59).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer A. Leung whose telephone number is 703-305-4951. The examiner can normally be reached on 8:30 am - 5:30 pm M-F, every other Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Marian C. Knode can be reached on 703-308-4311. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Hien Tran

Jennifer A. Leung
October 15, 2002

HIEN TRAN
PRIMARY EXAMINER